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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
KIANNI, KAVEH C	

ART UNIT	PAPER NUMBER
2883	

DATE MAILED: 01/28/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/646,927	CHEN ET AL.	
	Examiner	Art Unit	
	Kianni C Kaveh	2833	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 December 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-17 and 21-23* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☐ Claim(s) *1-9,15,17 and 23* is/are rejected.

7)☐ Claim(s) *1-7,10-14,16,21 and 22* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *25 August 2003* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

- Applicant's election without traverse of Group I claims 1-18 and canceling of nonelected claims 19-20 including claim 18 is acknowledged and therefore the election restriction made final.

Drawings

1. Figures 1 and 2 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance. As stated by applicant in at least page 10, lines 6-11 of the specification, the drawings of fig. 1-2 are prior art.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 1 recites the limitation "said elements" in line 13 of the claim. There is insufficient antecedent basis for this limitation in the claim.

Claim 2 recites the limitation "the incoming optical signal", "the input port", "the reception", "the output", "the electrostatic", 'the electrical load", "the incoming" between lines 3-12 of the claim. There is insufficient antecedent basis for this limitation in the claim.

Claim 3 recites the limitation "the incoming optical signal", “the input port”, “the reception”, “the output”, “the electrostatic”, ‘the electrical load”, “the incoming” between lines 3-13 of the claim. There is insufficient antecedent basis for this limitation in the claim.

Claim 4 recites the limitation "the fiber", “the light beam”, “the attenuation” in lines 2-9 of the claim. There is insufficient antecedent basis for this limitation in the claim.

Claim 5 recites the limitation "the fiber", “the light beam”, “the attenuation”, in lines 2-8 of the claim. There is insufficient antecedent basis for this limitation in the claim.

Claim 6 recites the limitation "the fiber", “the light beam”, “the light”, “the input fiber”, “the attenuation” in lines 2-10 of the claim. There is insufficient antecedent basis for this limitation in the claim.

Claim 7 recites the limitation "the multiple input channels " in line 2 of the claim. There is insufficient antecedent basis for this limitation in the claim.

Claim 16 recites the limitation "the flow channels", “the fluid”, in lines 2-6 of the claim. There is insufficient antecedent basis for this limitation in the claim.

Allowable Subject Matter

3. Claims 10-14, 16 and 21-22 are objected to as being dependent upon a rejected base claim, but would be *allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims*.

Claim 10 is allowable because the prior art of record, taken alone or in combination, fails to disclose or render obvious wherein the finger electrode shape of said comb drive

actuator of said micro-optical device is a kind of shape with an oblique angle thereby the generated force output from said comb drive actuator is enlarged for device designs and applications need large actuation force in combination with the rest of the limitations of the base claim.

Claim 11 is allowable because the prior art of record, taken alone or in combination, fails to disclose or render obvious wherein a clip type latch mechanism comprises a grip structure formed on the substrate of said micro-optical device to clamp said shuttle beam via the friction force formed at the contact interface of the clamped location between grip structure and shuttle beam in combination with the rest of the limitations of the base claim.

Claim 12 is allowable because the prior art of record, taken alone or in combination, fails to disclose or render obvious wherein the mirror surface of said micro-mirror of said micro-optical device is smoothed by applying the silicon etching solution to reduce the surface roughness that is formed during said DRIE process for making the micro-mirror sidewall from said silicon substrate in combination with the rest of the limitations of the base claim.

Claim 13 is allowable because the prior art of record, taken alone or in combination, fails to disclose or render obvious wherein the mirror surface of said micro-mirror of said micro-optical device is smoothed by adopting the (110) oriented silicon substrate as the initial substrate in conjunction with a post DRIE wet etching step in the silicon etching solution, thereby a silicon sidewall of smooth (110) facet is formed to be the mirror surface and the surface roughness of the just DRIE etched mirror is reduced in combination with the rest of the limitations of the base claim.

Claim 14 is allowable because the prior art of record, taken alone or in combination, fails to disclose or render obvious wherein the mirror surface of said micro-mirror of said micro-optical device is smoothed by a post DRIE oxidation step of the DRIE etched micro-mirror structure of said micro-optical device, thereby a silicon sidewall of smooth surface is formed in combination with the rest of the limitations of the base claim.

Claim 16 is allowable because the prior art of record, taken alone or in combination, fails to disclose or render obvious wherein the flow channels and trenches are formed on said substrate of said micro-optical device to let the fluidic materials and melted metals flow through inside said channels and trenches during the alignment, assembly, sealing, and packaging process; thereby the fragile MEMS elements will avoid from the damage caused by said fluidic materials in combination with the rest of the limitations of the base claim.

Claim 21 is allowable because the prior art of record, taken alone or in combination, fails to disclose or render obvious wherein the grip structure formed on the substrate of said micro-optical device to clamp said shuttle beam is via the friction force forming at the contact interface of the clamped location between grip structure and shuttle beam; thereby said micro-optical device maintains its status at certain states in an analog controllable manner without electrical power consumption when said clip type latch is used to clamp said shuttle beam in combination with the rest of the limitations of the base claim.

Claim 22 is allowable because the prior art of record, taken alone or in combination, fails to disclose or render obvious wherein the grip structure formed on the substrate of said micro-optical device to clamp said shuttle beam is via the electrostatic; force

forming between the gap between two side electrodes of grip structure when the two electrodes attract to each other, and come to contact with shuttle beam, where the electrodes of grip arm are coated with insulating materials and isolated from the shuttle beam; thereby said micro-optical device maintains its status at certain states in an analog controllable manner without electrical power consumption when said clip type latch is used to clamp said shuttle beam in combination with the rest of the limitations of the base claim.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

- This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claim 1, 8-9, 15 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mao et al. (US 2004/0223204) .

Regarding claims 1 and 15, Mao teaches a micro-optical device (shown in at least fig. 1) comprising: a reflective movable micro-mirror 21 connected with comb finger electrodes 37 and springs 16a,b via a shuttle beam 13; a set of suspended springs 17 connected with said shuttle beam 13 and with one end anchored onto a substrate 19; a comb drive actuator 36 consists a set of movable comb finger electrodes 37 suspended on a substrate 12 and connected with said shuttle beam 13, and a set of stationary comb finger electrodes 38 anchored on said substrate 12 (see parag. 0031); and a shuttle beam 13 movable with respect to the stationary portion of said substrate in response to operation of said comb drive actuator 36, thereby said micro-minor 21 is moved by this said shuttle beam 13; characterized in that,

However, Mao does not specifically teach wherein a portion of said springs is thinner than the rest portion of microelectromechanical structures of elements on the perpendicular out-of plane direction to said substrate of the device; and, wherein the device substrate of said micro-optical device is covered and sealed by a lid to protect the fragile MEMS elements including the micro-mirrors, comb drive electrodes, suspended springs, micro-optics, and MEMS actuators. Nevertheless, Mao states that depending the amount of load critical dimensions of the springs can be controlled/adjusted to be smaller (see at least parag. 0045 and 0066). Additionally, as shown in at least fig. 2, the springs 37 are shorter/thinner in Z direction of the perpendicular out-of plane direction to said substrate. Thus, it would have been obvious to a person ordinary skill in the art when the invention was made as a matter of design choice to produce at least a portion of the springs thinner/shorter in above direction and

also to use a conventional housing to house the above MEMS components since such modification would provide a micro-optical device in which the latching be non-contact for greater reliability and to minimize switching time, the mirror motion must be well controlled or damped to avoid optical signal oscillation, or ringing, before the mirror stabilizes (see parag. 0005).

Regarding claims 8-9, Mao further teaches wherein the set of springs consists four symmetric allocated folded-beam springs that these springs comprise at least one pair of compressive structures located on one side of said device regarding to center of device; and the spring constant along with the perpendicular in-plane direction to the moving direction of said set of springs is increasing as the moving displacement increased; therefore said micro-optical device is more robust to the side instability of finger electrodes in longer actuation displacement (see fig. 4, items 17 and 22; also parag. 0045-0046 and 0029-0030); wherein said set of springs consists a pair of normal folded-beam springs with U-shaped bridge joint, and a pair of compressive folded-beam springs located in a symmetric manner; and the spring constant along with the perpendicular in-plane direction to the moving direction of said set of springs is increasing as the moving displacement increased; therefore the micro-optical device is more robust to the side instability of finger electrodes (see parag. 0043, and 0045-0046, and 0029-0030);

Regarding Claim 17, Mao teaches a MEMS device (shown in at least fig. 1) comprising: a reflective movable micro-mirror 21 connected with comb finger electrodes 37,38 and springs 17,22 via a shuttle beam 13;

a set of suspended springs comprising at Least one pair of compressive structure, one end of said springs 17 is connected with said shuttle beam 13 and end the other end of said springs is anchored 19 onto a substrate 12,

a comb drive actuator 36 consists a set of movable comb finger electrodes 37 suspended on a substrate 12 and connected with said shuttle beam 13, and a set of stationary comb finger electrodes 38 anchored on a substrate 12,

a shuttle beam 13 movable with respect to the stationary portion of said substrate in response to operation of said comb drive actuator 36, thereby said micro-mirror 13 is moved by this said shuttle beam 13;

a clip type Iatch mechanism comprises a grip structure formed on the substrate 12 of said micro-optical device to clamp said shuttle beam 13 (see at least abstract and parag. 0027).

However, Mao does not explicitly state that the above MEMS device is a micro-optical device. It is well known/obvious to those of ordinary skill in the art when the invention was made that a MEMS device have optical elements such as optical fiber is considered to be micro-optical device, since such device would provide stabilized mirror with minimized switching time (see parag. 0005).

6. Claims 1-9 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over (Admitted Prior Art by the applicant depicted in figures 1-2 and described in at least pages 10 and 13-16 of the specification).

Regarding claims 1 and 15, the Admitted Prior Art teaches a micro-optical device (shown in at least fig. 1) comprising: a reflective movable micro-mirror 113 connected

with comb finger electrodes 119 and springs 123 via a shuttle beam 121; a set of suspended springs 123a,b connected with said shuttle beam 121 and with one end anchored 120 onto a substrate 116; a comb drive actuator 122 consists a set of movable comb finger electrodes 119 suspended on a substrate 116 and connected with said shuttle beam 121, and a set of stationary comb finger electrodes 118 anchored on said substrate 116; and a shuttle beam 121 movable with respect to the stationary portion of said substrate in response to operation of said comb drive actuator 122, thereby said micro-minor 113 is moved by this said shuttle beam 121 (see pages 13-16).

However, the Admitted Prior Art does not specifically teach wherein a portion of said springs is thinner than the rest portion of microelectromechanical structures of elements on the perpendicular out-of plane direction to said substrate of the device; and, wherein the device substrate of said micro-optical device is covered and sealed by a lid to protect the fragile MEMS elements including the micro-mirrors, comb drive electrodes, suspended springs, micro-optics, and MEMS actuators. Nevertheless, as shown in fig. 1, the springs 123a,b are shorter/thinner in Z direction of the perpendicular out-of plane direction to said substrate than that of element 117c of the stationary electrodes 118. Thus, in addition, it would have been obvious to a person ordinary skill in the art when the invention was made as a matter of design choice to produce at least a portion of the springs thinner/shorter in above direction and also to use a conventional housing to house the above MEMS components since such modification would provide a micro-optical device in which the latching be non-contact for greater

reliability and to minimize switching time, the mirror motion must be well controlled or damped to avoid optical signal oscillation, or ringing, before the mirror stabilizes.

Regarding claims 2-9, The Admitted Prior Art further teaches wherein the micro-mirror of said micro-optical device stays in an initial position without external electrical load, thereby the: incoming optical signals from one channel of the input ports transmit toward the reception optical fiber of one channel of the output ports; the set of movable comb drive electrodes which are connected with a movable shuttle beam move toward the stationary comb drive electrodes due to the electrostatic force between said two sets of comb drive electrodes when the electrical load is applied to the comb drive actuator, the micro-mirror connected with said shuttle beam move to the second stable position and stays at this position, thereby the incoming optical signals from one channel of the input ports transmit toward said micro-mirror, then said incoming optical signals being reflected toward the reception optical fiber of another channel of the output ports; therefore the input optical signals can transmit forward from one channel of input ports to an initial output channel when said micro-optical device maintains at its initial state without external applied electrical load, and when said micro-optical device under operation with external applied electrical load, said micro-optical device can switch said optical signals from one channel of input ports to a specified channel of output ports other than the initial output channel (see figures 1-2, mirror 113 and shut. beam 121 and at least page 13, 2nd parag.-page 15, 1st parag.+);

wherein the micro-mirror of said micro-optical device stays in an initial position without external applied electrical load, thereby the incoming optical signals from one channel of the input ports transmit forward said micro-mirror, and being reflected toward the reception optical fiber of one channel of the output ports; and, the set of movable comb drive electrodes which are connected with a movable shuttle beam move toward the stationary comb drive electrodes due to the electrostatic force between said two sets of comb drive electrodes when the electrical load is applied to the comb drive actuator, the micro-mirror connected with said shuttle beam move to the second stable position and stays at this position, thereby the incoming optical signals from one channel of the input ports transmit toward the reception optical fiber of one channel of the output ports without incident onto said micro-mirror; thus said micro-optical device can make said incoming optical signals from one channel of input ports be reflected by said micro-mirror toward a specified channel of output ports when said micro-optical device maintains at its initial state without external applied electrical load; and the input optical signals can transmit from one channel of input ports toward one channel of output ports due to these optical signals being reflected by said micro-mirror when said micro-mirror has been moved by comb drive actuator to the second stable position (see fig. 1-2, items actuator 122 and shuttle beam 121 and page 13, 2nd parag.-page 16);

wherein the fiber of input channel and the fiber of output channel are located and aligned along with the light beam transmission axis, and the micro-mirror of said microoptical device is located in the spacing between the fiber end of input channel and the fiber end of the output channel, and the light intensity of optical signals in

transmission is controlled and attenuated in terms of blocking a portion of the transmitted light beam, where the operation of blocking a portion of the transmitted light beam and thereby the attenuation range is determined by the position of said micro-mirror regarding to the actuation of said movable comb drive under external electrical load (see at least fig. 1-2 and page 15, 2nd parag.-page 16); wherein the fiber of input channel, the fiber of output channel, and the micro-mirror of said micro-optical device are located and aligned in a geometric layout configuration where the input light beam from the fiber of input channel reflected by said micromirror toward the reception fiber of the output channel; thereby all the input optical signals from the input fiber reflected by said micro-mirror toward the output fiber at the initial state of said optical device, and the attenuation range is determined by the position of said micro-mirror regarding to the actuation of said movable comb drive under external electrical load (see at least fig. 1-2 and page 13, 2nd parag.-page 16); wherein the fiber of input channel, the fiber of output channel, and the micro-mirror of said micro-optical device are arranged and aligned in a geometric layout configuration where all the light intensity of input optical signals from the input fiber are not coupled into the output fiber at the initial state of said optical device, and a portion of the input light intensity start to be coupled into the output fiber due to said micromirror moving to the corresponding position where said portion of the input light beam is reflected by said micro-mirror toward the output fiber, when the comb drive is actuated to move said micro-mirror under external electrical load; thereby the attenuation range is determined in terms of said micro-mirror position (see at least fig. 1-2 and page 13, 2nd parag.-page 16); wherein the multiple input channels of fiber

optics, the multiple input channels of fiber optics, and a plurality of reflective micro-mirror of said micro-optical device are located and aligned in a geometric layout configuration where the input light beam from one of the multiple input channels of fiber optics reflected more than one time by said reflective micro-mirror then transmitted toward one of the multiple output channels of fiber optics; thereby all the input optical signals being reflected more than one time by said micro-mirror toward the output channels; wherein the fiber optics comprise the optics integrated and assembled with the fibers and waveguides to achieve desired collimated light beam (see at least fig. 1-2 and page 13, 2nd parag.-page 16); wherein the set of springs consists four symmetric allocated folded-beam springs that these springs comprise at least one pair of compressive structures located on one side of said device regarding to center of device; and the spring constant along with the perpendicular in-plane direction to the moving direction of said set of springs is increasing as the moving displacement increased; therefore said micro-optical device is more robust to the side instability of finger electrodes in longer actuation displacement ((see at least fig. 1-2 and page 13, 2nd parag.-page 16); wherein said set of springs consists a pair of normal folded-beam springs with U-shaped bridge joint, and a pair of compressive folded-beam springs located in a symmetric manner; and the spring constant along with the perpendicular in-plane direction to the moving direction of said set of springs is increasing as the moving displacement increased; therefore the micro-optical device is more robust to the side instability of finger electrodes (see at least fig. 1-2 and page 13, 2nd parag.-page 16).

Citation of Relevant Prior Art

7. Prior art made of record and not relied upon is considered pertinent to applicant's disclosure. In accordance with MPEP 707.05 the following references are pertinent in rejection of this application since they provide substantially the same information disclosure as this patent does. These references are:

Bang et al. US 20030183008 includes teaching of conventional optoelectronic protective housing

Novotny 6827866 includes teaching of conventional optoelectronic protective housing

Kurdrle et al. 20020146200 includes teaching of conventional optoelectronic protective housing

Chen et al. 6804036

Yeh et al. 20020118850

Tsai 20040060898

Scan et al. 6257739

Jerman et al. 6836584

W. Noell, et a1., "Applications of SOI-Based Optical MEMS" IEEE J. on Selected Topics in Quantum Electronics, Vol. 8, No. 1, Jan/Feb 2002, pp.148-154;

C. Malmer, et a1., "A Variable Optical Attenuator Based on Silicon Micromechanics", IEEE Photonics Technol. Lett., Vol. 11, No. 2, 1999, pp. 233-235,

Marxer et al. "Micro-opto-Mechallical 2x2 Switch for Single-Motle Fibers Based on Plasma-Etched Silicon and Electrostatic Actuation" IEEE J. of Lightwave Teclmology, vol. 17, No. 1, 1999, pp.2-8;

Juan et al. "High-Aspect-Ratio Si Vel-tical Micromil-ror Al-rays for Optical Switching", IEEE J. Microelectromechanical Systems Vol. 7, No. 2, 1998, pp.207-213.

These references are cited herein to show the relevance of the apparatus/methods taught within these references as prior art.

Contact Information

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to K. Cyrus Kianni whose telephone number is (571) 272-2417.

The examiner can normally be reached on Monday through Friday from 8:30 a.m. to 6:00 p.m. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Frank Font, can be reached at (571) 272-2415.

Any response to this action should be mailed to:

Commissioner of Patents and Trademarks

Washington, D.C. 20231

or faxed to:

(703) 872-9306 (for formal communications intended for entry)

or:

Hand delivered responses should be brought to Crystal Plaza 4, 2021 South Clark Place, Arlington, VA., Fourth Floor (Receptionist).

Any inquiry of a general nature or relating to the status of this application should be directed to the Group Receptionist whose telephone number is (703) 308-0956.

K. Cyrus Kianni
Patent Examiner
Group Art Unit 2883

January 25, 2005